



A SCHEMATIC SYMBOLOGY FOR SYNTHESIZER PATCHING ARRANGEMENTS

INTRODUCTION

As any field progresses from the simplistic to the complicated the need arises for a system of short-hand notation that allows the individuals involved in the field of interest to easily and quickly document their experiences. Time used in elaborate, detailed drawings of the system under study is time lost to active investigation.

In the same way that the languages of man have progressed from pictures of men killing buffalos through stylized hieroglyphics to a small handful of symbols that can be used to convey even the most abstract concepts, so must other fields develop their own symbology to best fit the concepts that are to be recorded or passed on from one individual to another. It is with this ultimate goal in mind that we offer the following set of symbols and rules for their use.

Much of this work is not original but is borrowed from others in the field. We do not offer this as an ultimate system or in fact even as a system that offers significant advantages over others. Simply put; we had a need, this is a solution. We would be happy to hear from anyone with other solutions.

A GLOSSARY OF ABBREVIATIONS AND TERMS

<u>ADSR*</u>	Attack/decay/sustain/release. Abbreviation for envelope generator which describes this controller's four major output states.
<u>A. F.</u>	Audio frequency. Any cyclic phenomena that occurs with a frequency from 20 cycles per second to 20,000 cycles per second - the normal range of human hearing.
<u>AR*</u>	Attack/release. Abbreviation for function generator which describes this controller's two major output states.
<u>Attenuator</u>	A means of decreasing the amplitude of a signal without altering any other characteristic, ordinarily electro-mechanical.
<u>Balanced Modulator</u>	A means of combining two electronic signals in such a way that the individual frequency content of each signal is eliminated and replaced with a new signal that consists of frequencies that are sums and differences of the originals.
<u>B. P.</u>	Band Pass. Ordinarily used to refer to a filter whose characteristics are such that only signals within a narrow frequency band can pass through the filter.
<u>Center Frequency</u>	On a band-pass filter, the frequency at which maximum boost of the signal occurs.
<u>Corner Frequency</u>	Also cut-off frequency and center frequency. The critical frequency above or below which the amplitude of the signal is altered. e.g. A low pass filter attenuates signals below the corner frequency.
<u>C. V.</u>	Control Voltage. The ordinarily high level voltage that is used to control the characteristics of a processing element.
<u>db</u>	Decibels. Originally an exponential base measure of power gain but currently also used to indicate voltage gain. Gain in db. is equal to 20 times the base 10 logarithm of the voltage gain.
<u>Envelope Generator</u>	An automatic or semi-automatic means of generating control voltages with pre-set rates of change. See also AR and ADSR.
<u>Exp.</u>	Exponential.
<u>Filt.</u>	Filter. Any device that selects some characteristics of a thing and performs a sorting operation based on that characteristic. In electronic music ordinarily the characteristics on which the sorting is based is frequency.
<u>Freq.</u>	Frequency. Applied to cyclic phenomenon, the number of times that the phenomenon goes through a complete cycle in a given period of time. Ordinarily measured in cycles per second in electronic usage.
<u>Glide</u>	Also Glissando. The ability of an instrument to change slowly from one note to the next while sweeping all of the notes in between.
<u>H. P.</u>	High pass. Ordinarily used to refer to a filter whose characteristics are such that only signals above a certain frequency are allowed to pass through the filter.
<u>Hz.</u>	Hertz. Frequency in units of cycles per second.
<u>Inst.</u>	Instrument. Ordinarily indicated a natural instrument such as piano, etc.
<u>KBD</u>	Keyboard.
<u>kHz.</u>	Kilo-hertz. Hz X 1,000. e.g. 2,400 Hz = 2.4 kHz.

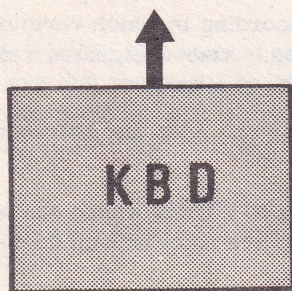
- Lin. Linear. Used to describe a condition in which one parameter of a system is directly related to the value of some other parameter. Also, a type of controller which offers an infinitely variable output as opposed to the discrete output states available from a keyboard.
- L. F. Low Frequency. Typically less than 25 Hz.
- L. P. Low pass. Ordinarily a filter whose characteristics are such that only signals below a certain frequency are allowed to pass through the filter.
- Mix. Mixer. In audio work a device used to combine two or more signals in such a way that no spurious or extraneous signals are generated in the process.
- Ms. Milli-second. The one thousandth part of a second.
- Multi-track A means of producing a complete recording in which various portions of the recording are recorded at different times. Also designates a recorder that is capable of recording more than one track at a time.
- Noise Ordinarily white noise (see white noise). Also any extraneous undesirable signal.
- Notch Filter Also band reject. Ordinarily refers to a filter whose characteristics are such that frequencies within a narrow band are rejected and do not pass through the filter.
- Osc. Oscillator. In electronics a means of producing a cyclicly varying voltage or current.
- Pink Noise (see also white noise). A sound composed of randomly varying amplitudes of all frequencies within a given narrow band of frequencies.
- Q Derived from Quality. Ordinarily applied to filters; a measure of the width of the pass band of a filter and how well frequencies outside of that band are rejected. As the number expressing Q increases the pass-band becomes more narrow and out-of-band rejection increases.
- Real time In music; indicates that a selection was played as heard, as opposed to a recording produced using multi-track techniques.
- Rev. Reverb. Ordinarily an echo-type effect produced by introducing a time delay to a signal using mechanical means; e.g. springs.
- SEQ. Sequencer. An electronic means of automatically controlling a time related series of events.
- Step Trigger A voltage output that immediately rises to a high level and remains at that level until some action causes it to return to zero. e.g. on a keyboard the step trigger rises when any key is pressed and remains high as long as any key is held down. Releasing all keys cause the step output to return to its low state.
- Trig. Trigger. An electrical change of state used to initiate an automatic or semi-automatic machine response.
- VCA Voltage controlled amplifier. An electronic amplifier whose gain is determined by the voltage or sum of voltages at a number of input points.
- VCF Voltage controlled filter. A filter whose key characteristics - ordinarily corner frequency and in some cases Q - are controlled by the voltage or sum of voltages at a number of input points.
- VCO Voltage controlled oscillator. An electronic oscillator whose frequency is controlled by the voltage or sum of voltages at a number of input points.
- VU Volume unit.
- Waveform The shape of one complete cycle of a periodic signal when amplitude is taken as a function of time, e.g. triangle, ramp, pulse, etc.
- White noise A signal composed of randomly varying amplitudes of all frequencies.

SYMBOLOLOGY

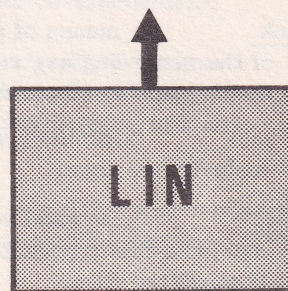
Synthesizer modules can be roughly broken down into three general categories:
(1) Controllers, (2) Signal sources and (3) modifiers.

CONTROLLERS

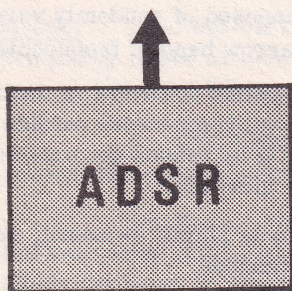
For our purposes we will consider a controller to be any source of high level control voltage and will represent them by an open horizontal rectangular box with the type of controller written into the box. Typical controllers would be:



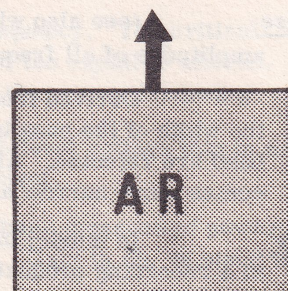
KEYBOARD



LINEAR CONTROLLER



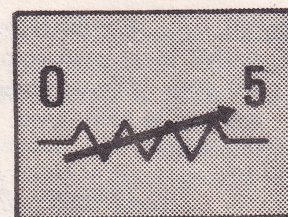
ATTACK/DECAY/SUSTAIN/RELEASE
ENVELOPE GENERATOR



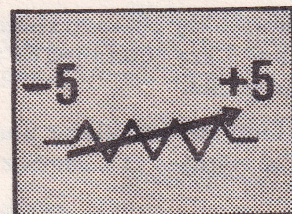
ATTACK/DECAY FUNCTION GENERATOR



SEQUENCER

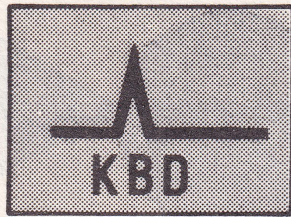


0 to 5 VOLTS BIAS SOURCE

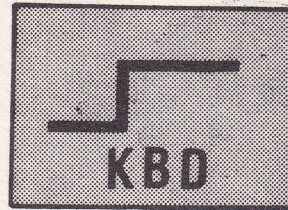


-5 to +5 VOLTS BIAS SOURCE

TRIGGER SOURCES:



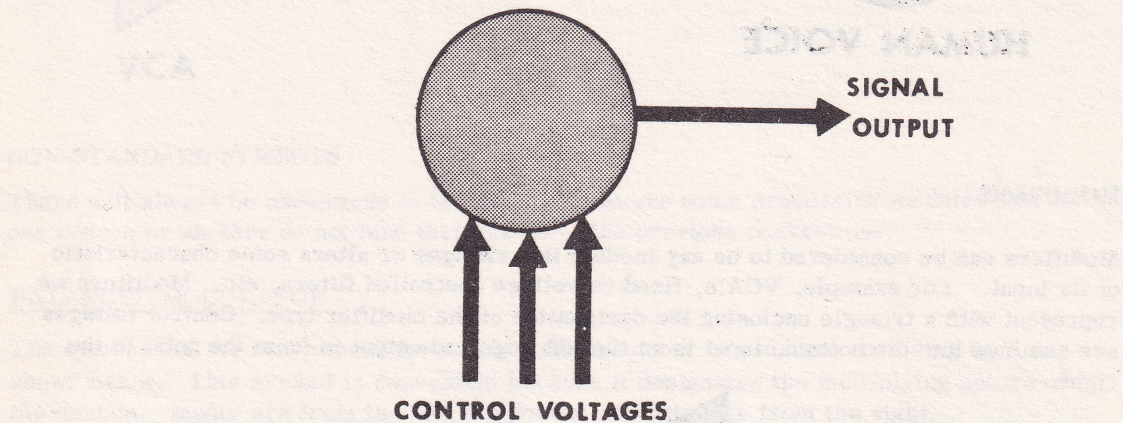
PULSE TRIGGER



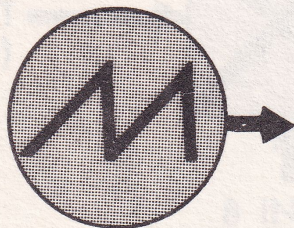
STEP TRIGGER

SIGNAL SOURCES

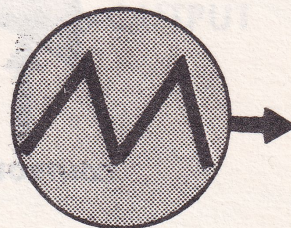
There are a wide variety of possible signal sources including VCO's, noise sources, conventional instruments and the human voice. We represent these sources with a circle enclosing the designation of the type of signal generated. Control voltages are shown summed into the bottom of the circle and the output of the source is in general from the right side as shown below:



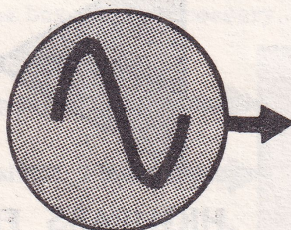
Typical signal sources would be:



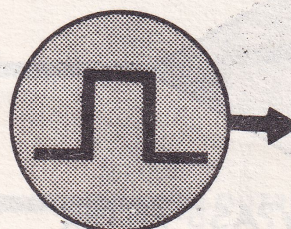
VCO (SAWTOOTH)



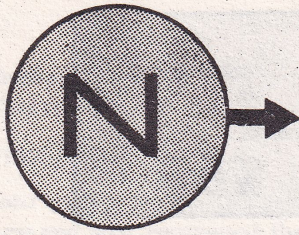
VCO (TRIANGLE)



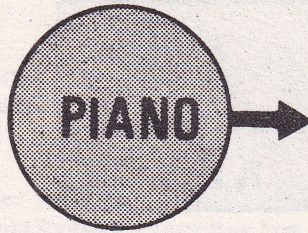
VCO (SINE WAVE)



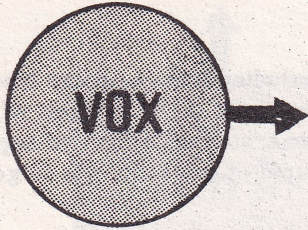
VCO (PULSE)



NOISE



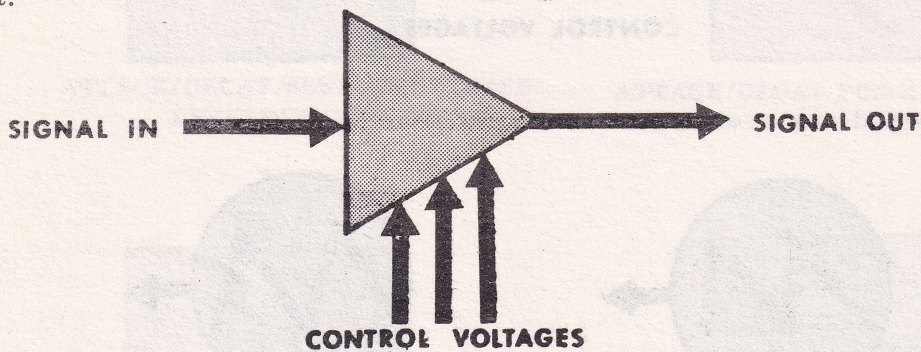
PIANO (OR OTHER)



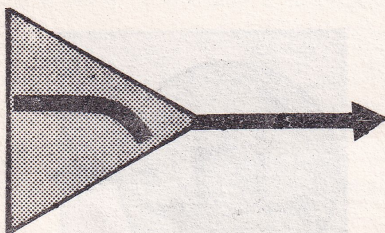
HUMAN VOICE

MODIFIERS

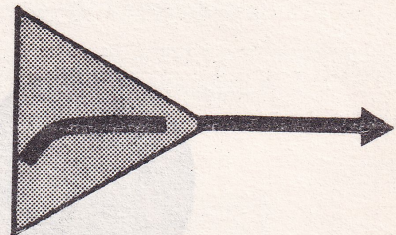
Modifiers can be considered to be any module that changes or alters some characteristic of its input. For example, VCA's, fixed or voltage controlled filters, etc. Modifiers we represent with a triangle enclosing the designation of the modifier type. Control voltages are summed into the bottom, input is on the left edge and output is from the point to the right.



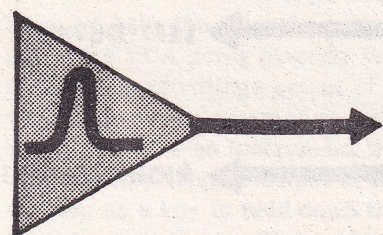
Typical modifiers would be:



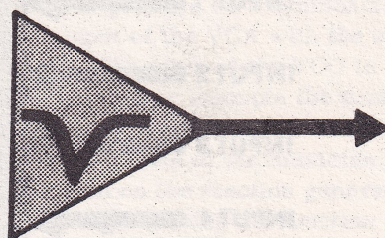
LOWPASS FILTER



HIGHPASS FILTER



**BAND PASS
FILTER**



NOTCH FILTER



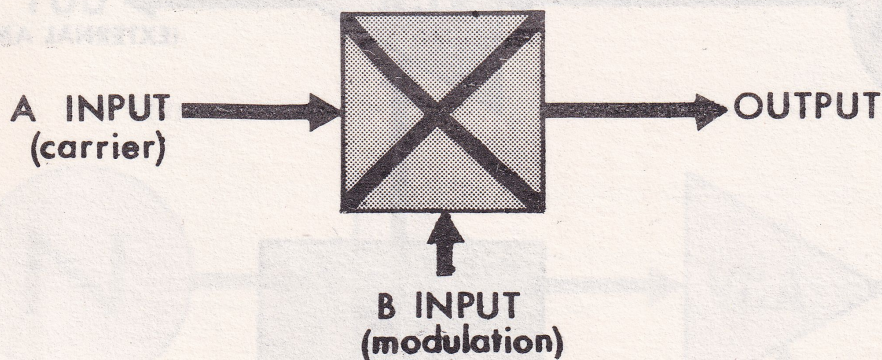
VCA

NON-STANDARD SYMBOLS

There will always be exceptions to the rules, there are some processing modules that for one reason or another do not lend themselves to the previous conventions.

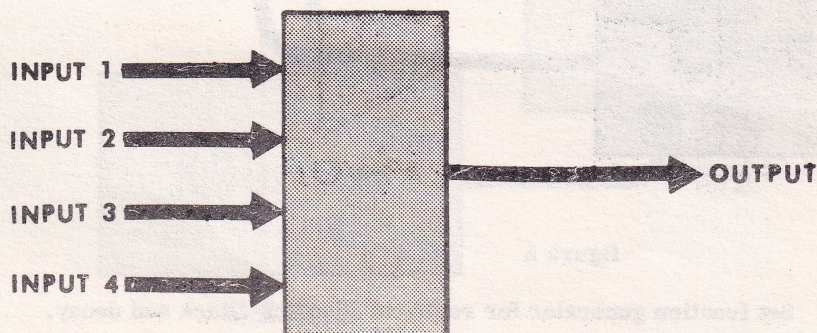
BALANCED MODULATOR

The symbol that we recommend for a balanced modulator is a square enclosing an X as shown below. This symbol is convenient because it designates the multiplying nature of the module. Inputs are from the left and bottom and output is from the right.

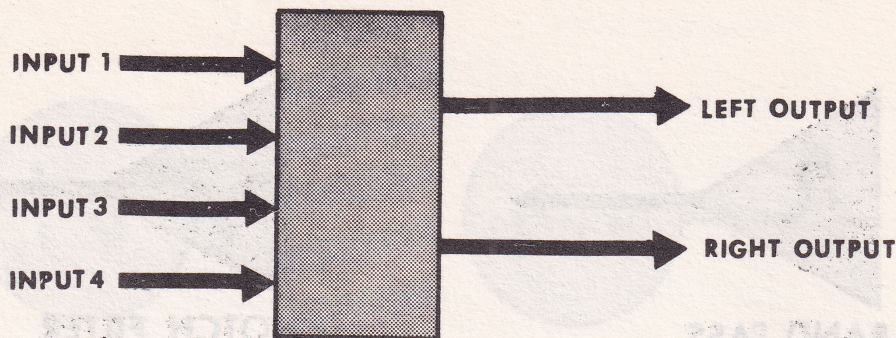


MIXERS

Mixers are easily represented by a vertical rectangular box with no further designation necessary. Inputs are to the left, outputs from the right. Percentages of mix may be written into the box where necessary.



4 CHANNEL MONO MIXER



4 CHANNEL STEREO MIXER

COMBINING THE SYMBOLS

There are really only two rules that need to be written concerning combining the symbols into a patch chart:

- 1) Where possible, audio signal flow is from left to right.
- 2) Where possible, control voltage processing is from bottom to top.

There will be times when it is impossible to strictly follow these rules and on these occasions the judgement of the user should be liberally applied. Ambiguous areas may be documented as a comment at the bottom of the chart.

EXAMPLES

The following examples of two common synthesizer voices show both symbolic representation of the patching arrangements as well as a pictorial view of the PAIA 2720 series modules used to implement that voice.

FLUTE

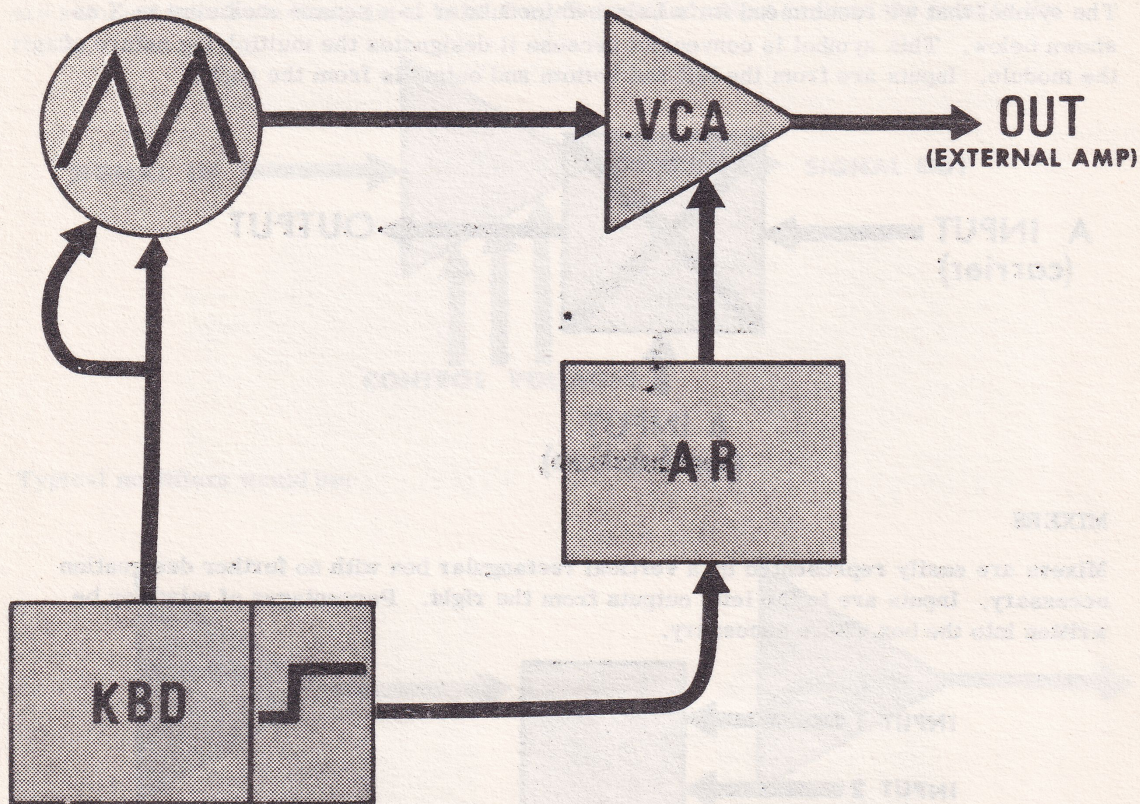


figure a

COMMENTS: Set function generator for realistic sounding attack and decay.

ANALYSIS: A flute sound is one of the easiest to produce on a synthesizer. Here we have the triangle output of a VCO feeding the input of the VCA with the output of the VCA going directly to the external amplifier. The pitch of the VCO is set by the control voltage output of the keyboard - in this particular example the control voltage is shown summed in twice thereby raising the pitch of the VCO by an octave. Since a flute is an instrument that sustains as long as the breath of the musician holds out, the step trigger output of the keyboard is used to turn on the function generator. As long as a key is held down the step trigger output is high causing the function generator output to stay high and hold the VCA on. A more pictorial patch chart using 2720 front panels would be:

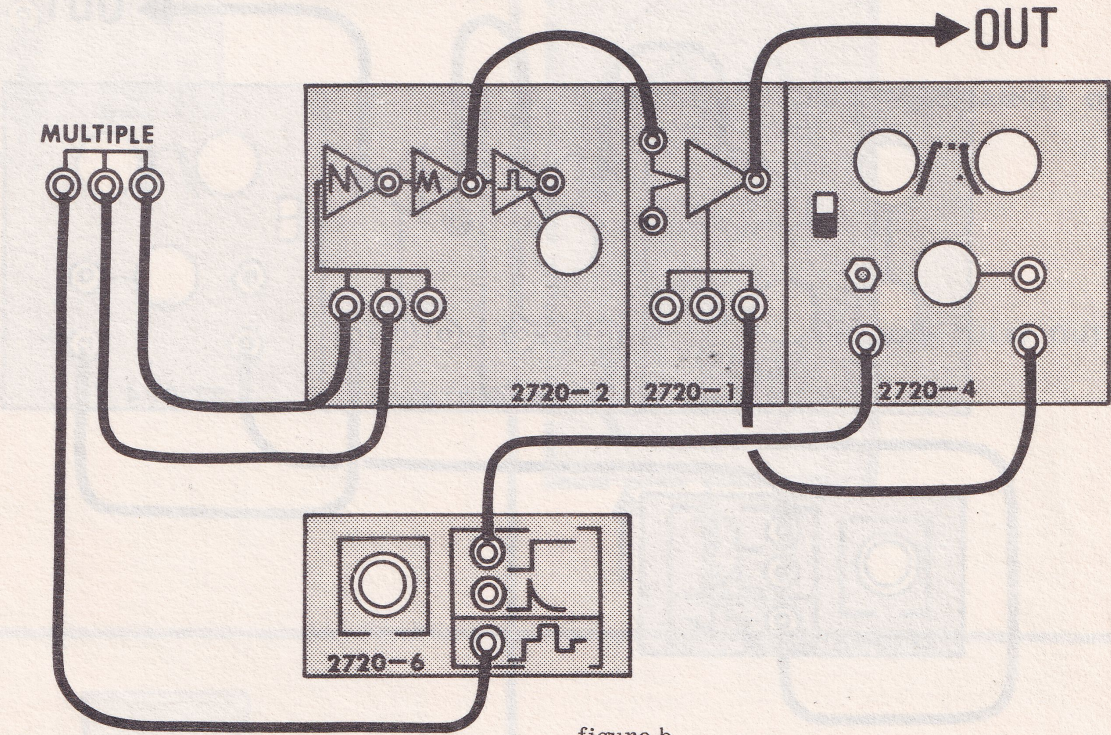
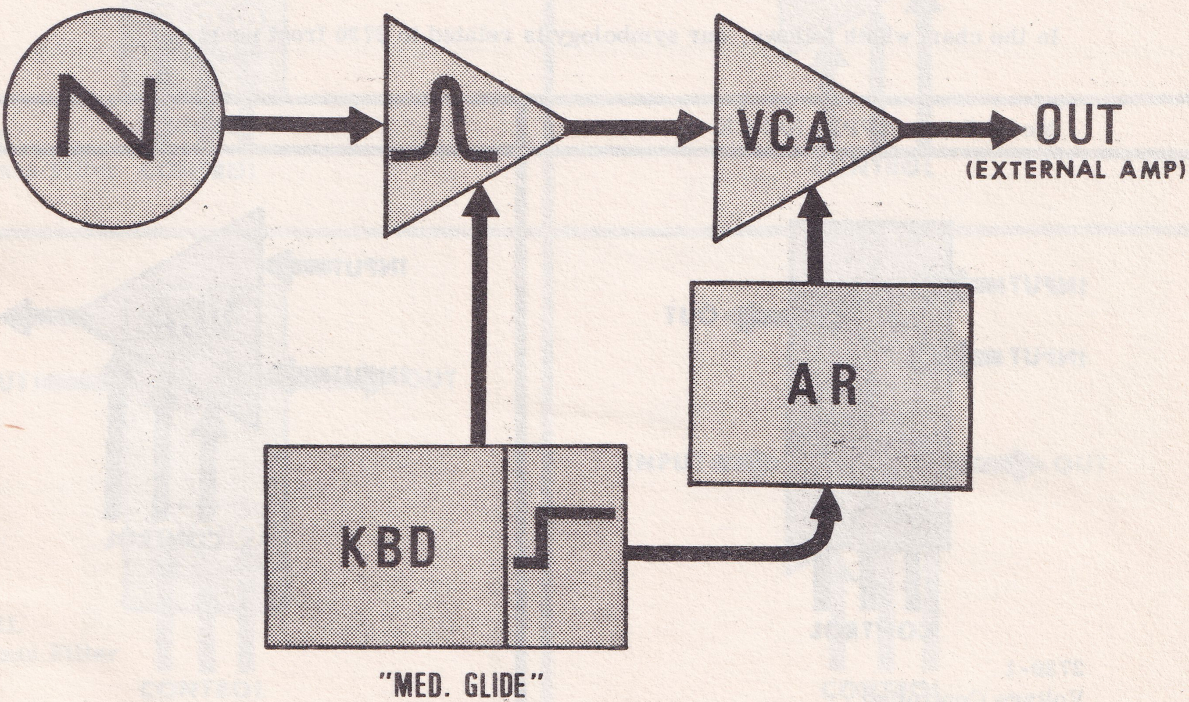


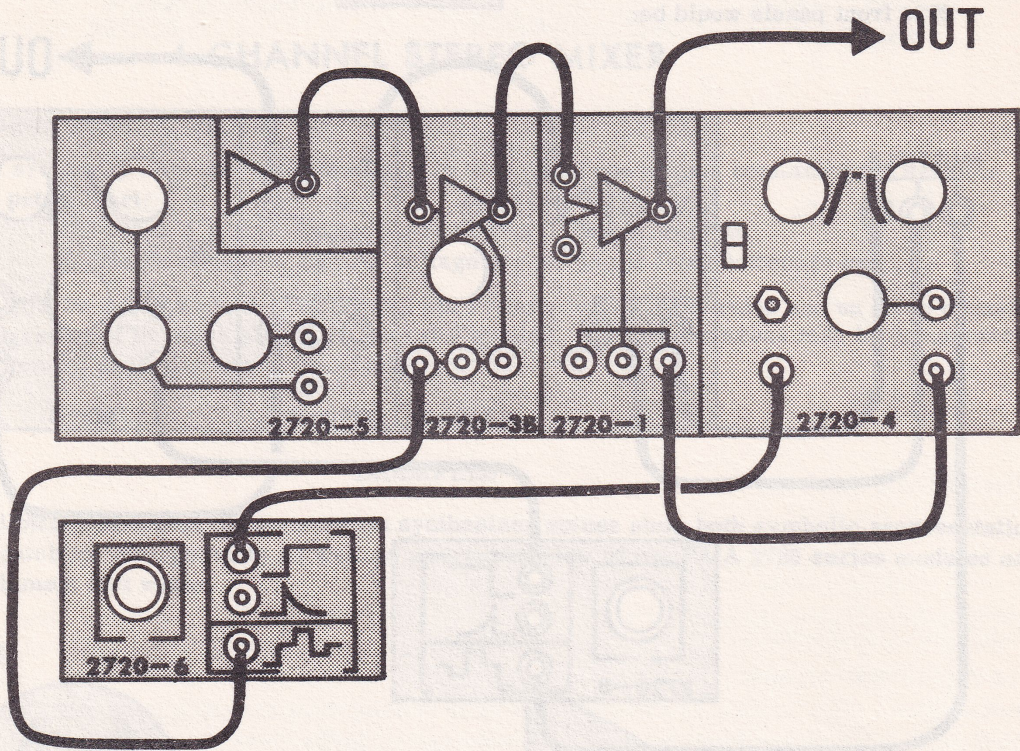
figure b

THE WIND



ANALYSIS Wind sounds are another easy synthesizer voice. The noise source output feeds the input of the band-pass filter which in turn feeds the VCA. Keyboard control voltage output sets the center frequency of the filter and the step trigger output turns on the function generator which controls the VCA. The notation "med. glide" indicates that on keyboards equipped with a glide, its control is to be set mid-range.

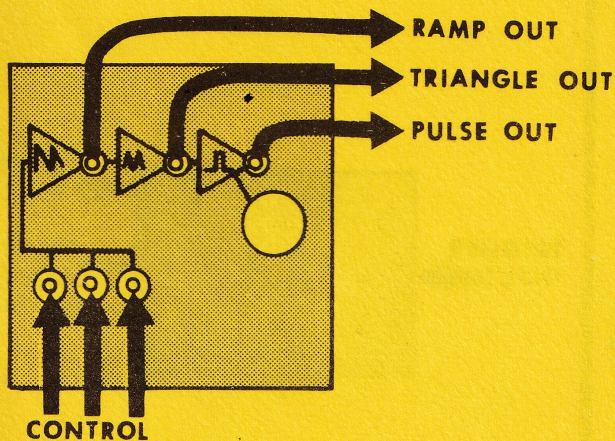
In terms of 2720 series modules this patch would appear as below.



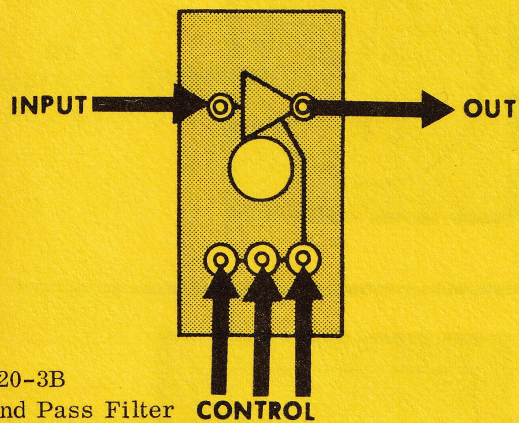
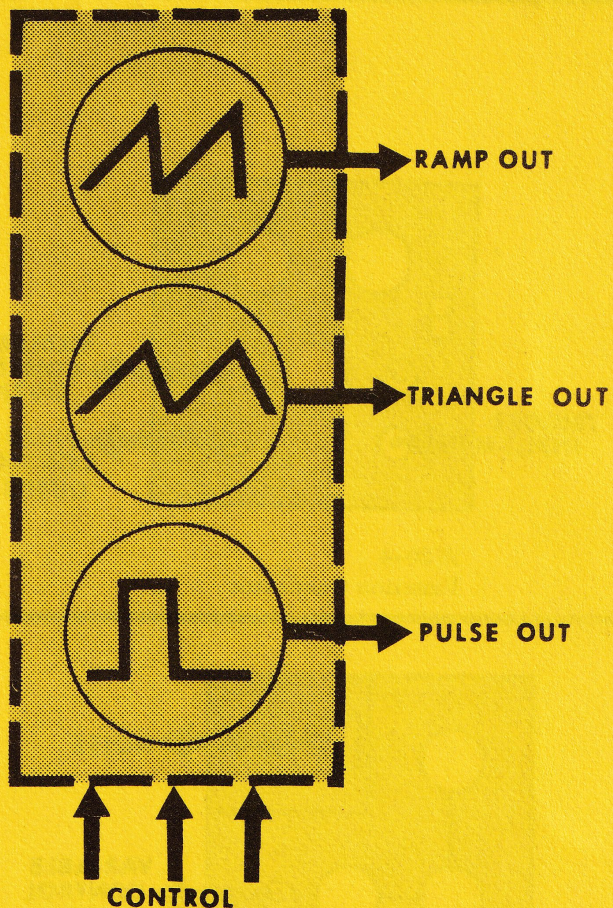
2720 / SYMBOLOGY EQUIVALENTS

In the chart which follows, our symbology is related to 2720 front panels.

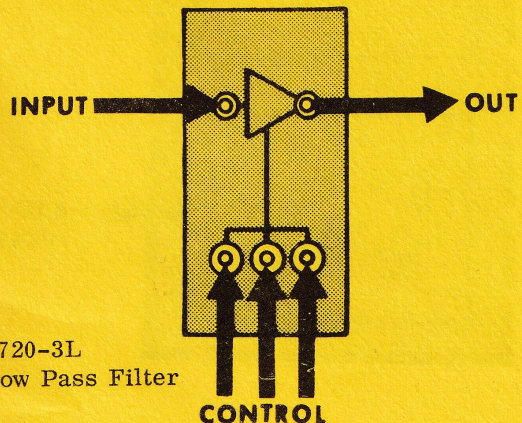
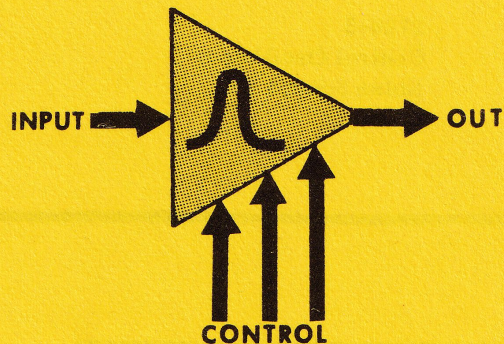
Model #	APPEARANCE	SYMBOL
2720-1 Voltage Controlled Amplifier		



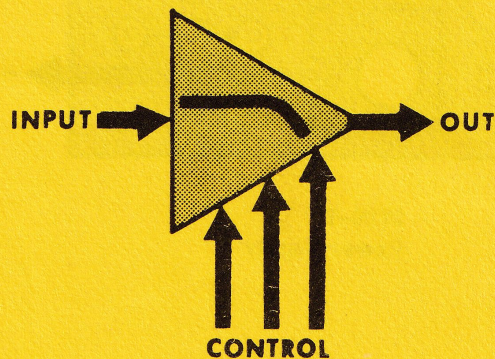
2720-2
Voltage Controlled
Oscillator

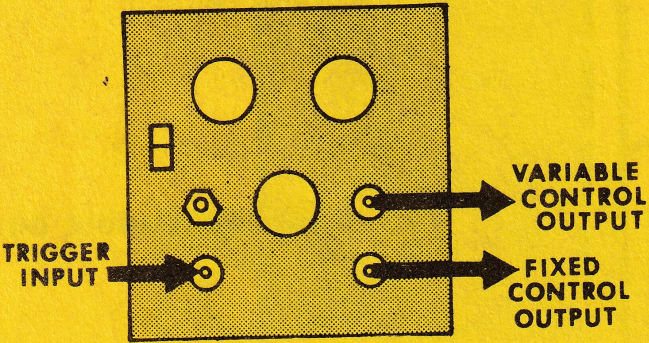

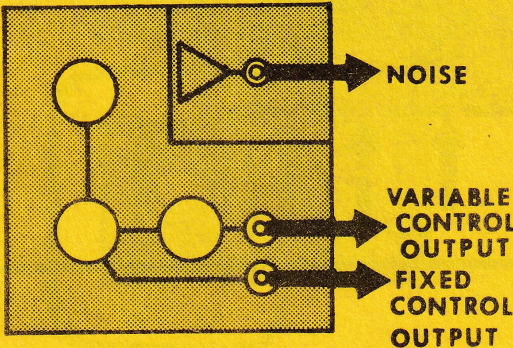
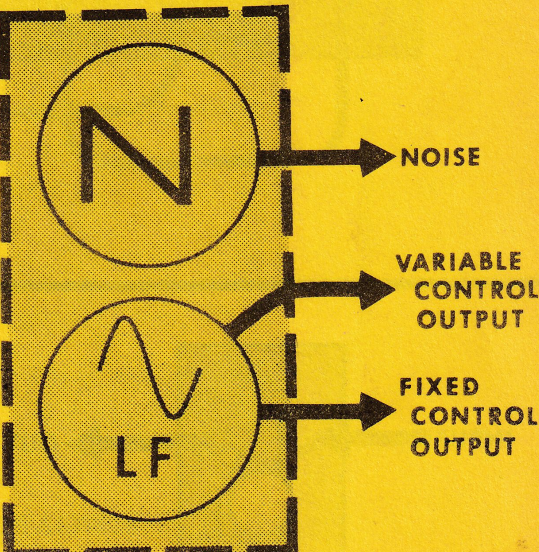


2720-3B
Band Pass Filter



2720-3L
Low Pass Filter



Model #	APPEARANCE	SYMBOL
2720-4 Function Generator		
2720-5 Control Oscillator/ Noise Source		
2720-7 Power Supply	